



Survey of the Fishing Cat *Prionailurus viverrinus* Bennett, 1833 (Carnivora: Felidae) and some aspects impacting its conservation in India

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The Fishing Cat *Prionailurus viverrinus* is one of the 15 felids that inhabit India (Nowell & Jackson 1996). Like the other small cats in the country, little is known about its ecology and conservation status. Existing knowledge on distribution and behaviour is based on observations mainly done many decades ago (Pocock 1939; Nowell & Jackson 1996; Sunquist & Sunquist 2002), with only a few serious systematic efforts into

Abstract: The Fishing Cat *Prionailurus viverrinus* is a medium sized cat that is widely but patchily distributed across Asia and strongly associated with wetlands. It is among the 15 felid species that inhabit India and like other smaller cat species it is very poorly understood. Apart from a few recent surveys in specific locations, no concerted effort has been made to assess its current distribution and threats to its persistence within India. In this study we collected scats from natural habitats, through six states including five protected areas throughout India and performed informal interviews with locals to get a better overview of the current distribution and threats for Fishing Cats in India. Of the 114 scats used for molecular analysis, 37% were assigned to felids, including 19 Fishing Cats. We confirmed that Fishing Cat populations persisted in all locations where they were recorded before, including Keoladeo Ghana, from where it was reported in recent years that fishing cats are possibly extinct. Most populations face imminent threats with the worst being in the Howrah District of West Bengal where 27 dead individuals were traced during the study period of only one year. The major threats across populations include ecologically unbalanced land policies and land uses, direct persecution due to human-Fishing Cat conflicts as well as ritual hunts. To address these threats we recommend a stronger dialogue among scientists, policy makers, administrators, locals and other stake holders such as commercial fish and prawn cultivators. Further awareness campaigns for stakeholders, and surveys for monitoring fishing cat populations, studying their ecology and estimating economic losses to local people due to the Fishing Cat predation on livestock and poultry, is needed in order to design effective conservation strategies.

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determining their current distribution or status within the country (Kumara & Singh 2004; Kolipaka 2006; Datta et al. 2008). The Fishing Cat is included in the Schedule I of the Indian Wildlife (Protection) Act (Anonymous 1972) and listed as Endangered in the 2010 assessment of the IUCN Red List of Threatened Species (Mukherjee et al. 2010a), as throughout its range the Fishing Cat habitat is severely threatened (Mukherjee et al. 2010a). Fishing Cats are wetland specialists and early accounts on their distribution in India suggest that they occur around major wetlands and mangroves

Abbreviations: DNA - Deoxyribonucleic Acid; PCR - Polymerase Chain Reaction; NCBI - National Centre for Bioinformatics.

across the country (Pocock 1939; Nowell & Jackson 1996). These ecosystems are highly threatened due to competition for resources with humans, such as land, water and fish. Several wetlands across India are rapidly being converted into agricultural land, fragmented or destroyed, to meet the demands of a burgeoning human population (Prasad et al. 2002). In the 2010 IUCN assessment it was believed that the westernmost Fishing Cat population in India (in Keoladeo Ghana National Park, Bharatpur, Rajasthan) was already extinct since there were no reports for a couple of years (Mukherjee et al. 2010a; Bholu Abrar Khan pers. comm. 07 February 2011).

The distribution of the Fishing Cat is intriguing since it is widespread but patchy, from Bharatpur in Rajasthan, along the Himalayan foothills, through eastern India into Andhra Pradesh (Pocock 1939; Nowell & Jackson 1996; Sunkuist & Sunkuist 2002; Kolipaka 2006). With earlier records of the cat being largely restricted to protected areas (Nowell & Jackson 1996), it was not known if viable populations of this species occurred outside protected areas. Further, details of threats to the species and the current conservation status remain largely unknown. Recent surveys (Kumara & Singh 2004; Datta et al. 2008), through camera trapping and interviews with locals, did not record Fishing Cats, but it remained unclear if this was a result of the cryptic lifestyle of the species or if the absence is an indication of its actual status. In this study we mainly focussed on the molecular analysis of non-invasively collected faecal samples to elucidate the presence of Fishing Cats.

This paper is an overview of the current distribution and threats for Fishing Cats in India. We focussed on regions known to have Fishing Cat populations, in order to update information on presence, persistence and conservation status and did not aim to survey new potential sites of presence.

Material and Methods

The study was conducted between April 2010 and May 2011.

Survey for presence through scat collection and analysis: Field sampling for scats was done mainly in the drier winter months from November 2010 to February 2011, except for a site in Andhra Pradesh (Coringa mangroves) that was sampled in June 2010. The monsoon months (June to September) could not be

utilised for sampling since scats exposed to water often do not give good results due to fungal attacks or because the outermost layer containing intestinal cells is washed off (Mukherjee et al. 2010b). The survey was conducted through the states of Andhra Pradesh (Coringa Wildlife Sanctuary), Odisha (Mangalajodi), West Bengal (Howrah, Hooghly, Sundarbans, Jhargram), Uttar Pradesh (Dudhwa National Park, Katarniaghat Wildlife Sanctuary), Uttarakhand (Corbett Tiger Reserve), Rajasthan (Keoladeo Ghana National Park) (Fig. 1).

Within each locality sampled, scats were collected from areas where the probability of locating Fishing Cat scats was high (areas with large water bodies and reed beds especially those that had culverts and bridges close by, since from earlier observations these were areas marked profusely by Fishing Cats). Since in any given area several similar sized carnivores coexist, all potential carnivore scats were collected. Only a small portion of the scat was collected, dried with a hair dryer on medium heat and intensity and couriered to the laboratory at the National Centre for Biological Sciences where further analysis was conducted.

DNA extraction was done using commercially available QIAmp (QIAGEN) stool and tissue kits with minor modifications in incubation periods of the manufacturer's protocol (see Mukherjee et al. 2007 for details). All extractions were done in a separate room, free from PCR products and any source of contamination. Controls were added to every extraction batch to monitor contamination. We used the 16s rRNA felid specific primers for species identification. PCR and sequencing protocols are described in Mukherjee et al. (2010b). Sequences were aligned with the only reference sequence from GenBank (accession number: AF006451.1 GI:2218235) for species identification.

Assessment of threats: A semi-structured questionnaire (Appendix 1) was used to interview a total of 200 villagers (from Howrah and Hooghly districts of West Bengal) between 45–60 years of age. Ten people were interviewed from each village for a total of 20 villages in order to assess potential threats of Fishing Cats. In Howrah, West Bengal, a more detailed examination of threats was conducted by one of the authors (Tiasa Adhya). She interviewed 20 people from 38 villages of different age groups with around 40% of the interviewees falling in the age category of 30–50. Causes of deaths were collected through a network of local informers. In some cases the villagers who killed

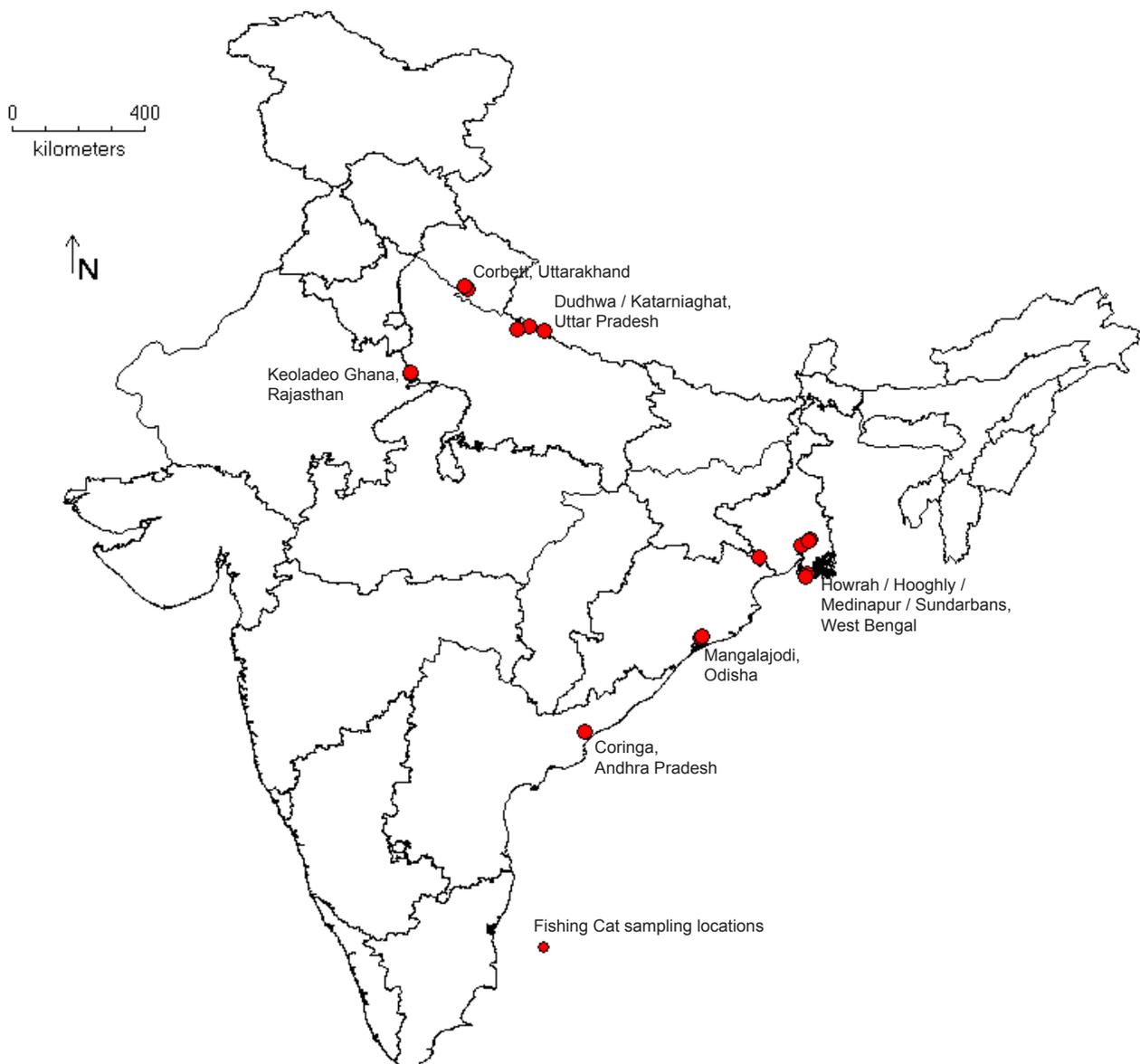


Figure 1. Locations of sampling for scats

the cats themselves contacted the survey team and in most cases (barring a couple) the dead Fishing Cats were photographed as evidence.

Results

Survey for presence: In all, 151 scat samples were collected from the surveyed regions including a tissue sample of a Fishing Cat that was killed by villagers in Aima Village, Howrah District, West Bengal. Since Fishing Cats defecate in ‘latrines’ and several scats of the same individual can occur in a single location, we used just a single scat that provided results on the first instance. Hence, of the 151 scats collected from natural habitats DNA was extracted from 114. DNA extracts

from 37 scats (32.5%) amplified with the felid specific primers and results are listed in Table 1.

PCR products of four scats failed to produce reliable sequences and thus were excluded from the analysis. Of the remaining, 19 were identified as Fishing Cat scats and the rest were of Jungle Cat *Felis chaus* (N = 11) and Leopard Cat *Prionailurus bengalensis* (N = 3) (Table 1). Fifteen of the 19 Fishing Cat scats were from West Bengal and the Terai region of Dudhwa/Katarniaghat. No Fishing Cat scat was located from Corbett National Park. The Fishing Cat scat located in Keoladeo Ghana National Park, Bharatpur proved recent claims of its potential extinction in this area wrong. Following this rediscovery a Fishing Cat was observed not far from the

place the scat was found (see discussion).

Assessment of threats: Table 2 lists observed threats faced by Fishing Cats (potentially also other wildlife species) in the different study regions. Habitat loss attributed to land use policy and economic developments (commercial fisheries/aquaculture, brick industries, agriculture) are a major threat in some areas. In Kolkata a pair of Fishing Cats was captured in the vicinity of the International airport and is now housed in the Kolkata Zoo.

Other threats were very specific to the region, such as the red algae covering the wetlands of Keoladeo Ghana. This is perceived to be a threat since the algae forms a thick layer over the surface of the water, especially around the banks and completely obscures visibility. For the Fishing Cat that most likely requires clear visibility around banks of water bodies to catch fish, this could be a severe problem.

No conflict or killing was reported by villagers of the Terai belt of Dudhwa and Katarniaghat, despite several reports of Fishing Cats occurring in sugarcane fields around the Tiger Reserve.

In contrast 27 Fishing Cats were killed due to various human related causes (Table 3) in West Bengal,

26 from Howrah District and one from Hooghly. The most common cause of death was from poisoning.

Discussion

Presence and persistence: Despite surveying widely and specifically at sites where the probability of Fishing Cat occurrence would be high, only 19 Fishing Cat scats were obtained (Table 1). The survey period was short and very widespread and hence intensive sampling in each location was not possible. That is perhaps the reason why Fishing Cat scats were not found in Corbett National Park. However, their presence in that region is corroborated by a camera trap picture taken, very recently, by the Wildlife Institute of India (Dehradun) team (Abishek Harihar pers. comm. 25 March 2012).

There are also technical reasons for low success such as some scats having very low amounts of predator DNA. This is particularly relevant to scats collected from within mangrove forests that have been exposed to the tide. This was perhaps the case with some scats collected in the Coringa mangroves that failed to produce results (Table 1). Nevertheless, the survey served as an overview since it established persistence of the species in areas known to be within the broad

Table 1. Summary of results of scat collection and identification

Region	Scats collected	Extracted for DNA	16srRNA amplification (% success)	Fishing Cat	Jungle Cat	Leopard Cat	Sequence failed
Andhra Pradesh: Coringa mangroves	10	10	2 (20%)	2	0	0	0
West Bengal: Sundarbans, Hooghly, Howrah	55	49	11 (22.4%)	7	1	0	3
Uttar Pradesh: Dudhwa & Katarniaghat Tiger Reserve	36	30	12 (40%)	8	1	2	1
Rajasthan: Keoladeo Ghana National Park	32	18	9 (50%)	1	8	0	0
Uttarakhand: Corbett National Park	7	3	1 (33%)	0	0	1	0
Odisha: Mangalajodi	11	4	2 (50%)	1	1	0	0
Total	151	114	37 (32.5%)	19	11	3	4

Table 2. Threats to Fishing Cat populations in various parts of their range (2010–2011).

Region	Current Threats
Andhra Pradesh: Coringa mangroves	Commercial aquaculture (prawn farms)
West Bengal: Sundarbans, Hooghly, Howrah, Medinapur	Land use policy in urban and rural areas, conflict around villages (poultry/livestock depredation), traditional hunting, poaching for meat and skin, agriculture, brick industries, commercial fisheries/aquaculture.
Uttar Pradesh: Dudhwa & Katarniaghat Tiger Reserve	Safe
Rajasthan: Keoladeo Ghana National Park	Very small population (only one record), extensive layer of red algae on water surface
Odisha: Mangalajodi	Conflict around fishing villages

Table 3. List of dead Fishing Cats encountered during the study period

Date	Cause of death	Number of individuals	Village
Apr-10	Poisoning	3	Wadipur
Apr-10	Poisoning	1	Kushberia
Apr-10	Strangulation	1	Aima
Apr-10	Trap cage	1	Kashipur
Jun-10	Poisoning	1	Tajpur
Jul-10	Trampling	1	Gorchumuk
Aug-10	Ritual hunt	3	Jamdana
Sep-10	Poisoning	1	Kumargarh
Sep-10	Trap cage	1	Mirzapur
Sep-10	Trap cage	1	Morshal
Oct-10	Ritual hunt	2	Deulpur
Nov-10	Poisoning	1	Delpur
Dec-10	Poisoning	3	Kashipur
Jan-11	Poisoning	2	Deulpur
Feb-11	Poisoning	1	Ulughara
Mar-11	Poisoning	1	Bargram
Mar-11	Train	1	Dankuni
Mar-11	Poisoning	1	Mahishamuri
Mar-11	Poisoning	1	Nuntia
Total		27	

historical distribution range of the Fishing Cat.

In some cases the survey established presence in areas that were unofficially known to have Fishing Cats but were not reported or documented in detail anywhere e.g. in the villages of Howrah and Hooghly districts of West Bengal. Hence the survey also helped compile information that is not available easily in published literature. This is in some ways reassuring for any conservation program since it indicates that Fishing Cat distribution is not as patchy as earlier believed. The presence of the species in agricultural landscapes bears great potential for maintaining continuity of populations across their range in India. This is however, somewhat speculative since information from Assam and parts of Andhra Pradesh and Odisha are missing for estimating real physical connectivity in habitat. However, a phylogeographic study with adequate samples from different regions of India could reveal how isolated Fishing Cat populations are currently and also have been throughout the Holo and Pleistocene.

Assessment of threats

General threats: Rapidly changing land regimes and

policies that do not include ecological aspects seem to be a general threat for this species across regions within the country. These land use changes vary among states and these are outlined below along with other threats.

West Bengal: The population in West Bengal in human dominated landscapes, outside protected areas seems to be under the most severe threat from multiple causes. Land policies that do not consider ecological and conservation aspects are a major issue especially in and around Kolkata and suburbs which include the districts of North and South 24 Paraganas, Hooghly, Howrah and Nadia. South Kolkata which is now heavily developed, is part of South 24 Paraganas (which also includes the Sundarbans, the largest patch of contiguous mangrove forests in the world) and still has remnants of wetlands and mangroves (e.g. around the International Airport). The capture of a pair of Fishing Cats around the airport a couple of years ago (Kolkata Zoo Director pers. comm. 08 December 2010), indicates that the species still persists there but is perhaps under severe threat from rampant unplanned urbanisation. Sunquist & Sunquist (2002) report four Fishing Cats being killed near Kolkata in the late 1980s. They also mention that a century ago the species was abundant in this region but are very rare since the past few decades. Although urbanisation cannot be prevented, planning the spread of cities by incorporating ecological aspects through dialogue among scientists, policy makers and the administration would be a step forward.

In the Sundarbans, locals on Sagar Island talked about not seeing the Fishing Cat anymore and admitted to have exterminated the species themselves due to conflict (poultry and livestock depredation). Similarly, the records of 27 killings in a year, in just the Howrah and Hooghly districts of West Bengal, are alarming since these are only a few that were encountered and many have very likely gone unnoticed and unreported.

Though villagers state that the Fishing Cat causes losses to them due to livestock and poultry depredation and also to fishing nets and fish stock, often the mere sighting of the cat induces killing due to the cat's habit of preying on livestock and poultry. These losses have never been assessed or quantified economically.

However, within the Sundarbans on the whole, Fishing Cats seem to be doing well and seem to be relatively common as they are also often trapped in cages set up by the forest department in cases of livestock depredation (Rishi Sharma pers. comm. November

2010; West Bengal Forest Department pers. comm. 26 December 2010).

Mushrooming brick industries are another threat in West Bengal and many wetland areas that were strongholds for Fishing Cats are now being destroyed to accommodate these industries.

Community level conservation efforts in privately owned lands are an option and this is being taken up through awareness campaigns through local NGO's and interested individuals. However, this needs to be systematised for continual funding and monitoring for long term gains.

Andhra Pradesh: Introduction of aquaculture and prawn farms around the Coringa mangroves in Andhra Pradesh (Ravishankar et al. 2004) is a potential threat to the Fishing Cat in the future. Such large aquaculture projects are bound to attract species that feed on fish and prawns. Scats of Fishing Cat were found adjoining a huge commercial tiger-prawn farm just outside the mangrove sanctuary and very likely Fishing Cats feed on tiger-prawns there. So far there are no reports retaliation, but this could also be due to ignorance of the presence of the cat that feeds in these commercial aquaculture farms. It is not known if this will be seen as conflict in the future as observed in villages in the Howrah District of West Bengal. One way to address this is to start sensitising locals and policy makers to the presence and importance of Fishing Cats and the law protecting it, in the region and enforce strict implementation of the law if killings are reported. Such regions need to be regularly monitored by the forest department to establish the presence of the cat so that any retaliatory killing does not go unnoticed.

Rajasthan: In the case of the Keoladeo Ghana population, monitoring and surveys are required to investigate the possibility of individuals having dispersed to the satellite wetlands around. Intensive surveys in and around Keoladeo Ghana through sampling scats and using molecular tools would provide valuable information on their presence, distribution and abundance. After communicating to the forest department on the possible adverse impact of the red algae, the management immediately started clearing off the algae in some places.

Conclusion

Although the Fishing Cat was recorded in all regions where it occurred earlier, its situation in a large part

of its range is precarious. Especially the population in West Bengal face numerous threats, which is particularly concerning as this state, especially the southern districts, may be a stronghold for this species. Here a conservation programme should monitor these populations and assess the impact of the observed threats. Economic losses to locals have to be quantified to gauge their impact to the local economy. If the losses are substantial urgent measures need to be taken to resolve it in order to minimise conflict. These can be in the form of insurance/compensatory schemes and/or changes in the way livestock and poultry are housed (Bhatnagar et al. 2002) and fish captures and nets should be guarded or fenced. Of particular importance are also surveys in regions connecting known populations to ensure habitat continuity. Here the satellite wetlands around Keoladeo Ghana in Bharatpur, the East coast wetlands and mangroves in the states of Odisha (e.g. Mahanadi), Andhra Pradesh (e.g. Krishna, Godavari basins) and Tamil Nadu (e.g. Pulicat Lake, Pichavaram and Muthupet) are particularly important. The occurrence of the species along the Western Ghats is not clear and needs investigation (Nowell & Jackson 1996; Sunquist & Sunquist 2002) and there have been no reports of this cat along the southern edge of the eastern coast of India.

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Appendix 1. Questionnaire used for assessing threats

Name –
Age –
Location –
(Show pictures of fishing cat, jungle cat, otter, small Indian civet, palm civet to help them identify)

A) Regarding Fishing Cat

1. What do you call Fishing Cat locally?
2. How many times have you seen Fishing Cats in your lifetime?
 - a. Never
 - b. 5-10 times
 - c. More than that
3. How many times have you seen Fishing Cats within one year?
 - a. Never
 - b. 5-10 times
 - c. More than that
4. When have you seen them?
 - a. Dawn
 - b. Morning
 - c. Afternoon
 - d. Dusk
 - e. Night
5. Have you seen adults or babies?

B) Threats

1. Have you ever killed Fishing Cats?
Yes/No
2. If yes, how many have you killed?
 - a. 0
 - b. 1-3
 - c. More than that
3. If you have, then what was the reason?
4. Do you know that it is illegal to kill Tigers? (Yes/No).
In the same way, do you know that Fishing Cats are protected by law?
Yes/No
5. Do you know that you can get arrested for killing Fishing Cats?
Yes/No
6. Have you ever seen or heard about tribal people killing Fishing Cats in your area?

C) Habitat

1. Do you know where Fishing Cats live?
 - a. Hogla
 - b. Boroj
 - c. Other (specify)

2. Do you know that they live in wetlands?
Yes/No

3. Was the expanse of wetlands more 20 years ago than it is now?
Yes/No

4. Are wetlands shrinking according to you?
Yes/No

5. What do you think are the reasons behind degradation of wetlands?

D) Man-animal Conflict

1. Have cats ever killed your poultry?
Yes/No
2. On an average how many of your animals are killed every month by Fishing Cat?
 - a. 0
 - b. 1-5
 - c. More than that
3. Are the chickens kept in coops?
Yes/No
4. Have the coops/fence protecting your livestock ever been broken by Fishing Cat?
Yes/No
5. Do Fishing Cats eat fish from your pond?
Yes/No
6. How do you know that Fishing Cats have eaten the fish and not any other animal like jungle Cat, Civet or Otter?
7. Were you ever attacked by them when you saw them?
Yes/No

E) Threat Mitigation

1. Do you have any nature clubs or NGOs related to wildlife conservation in your area?
Yes/No
2. Are you a part of such an organization?
Yes/No
3. If no, then would you like to be?
Yes/No
4. If we compensate for your livestock killing, would you stop persecuting the fishing cats?
Yes/No.

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